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Redescription of *Plagiopholis styani* (Serpentes, Pseudoxenodontidae), with description of two new species from China

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Abstract

During a long period, the genus *Plagiopholis* included four species and was extremely scarce. One of the members, *Plagiopholis styani* Boulenger, 1893, was treated as a single species widely distributed in the Dongyang domain of China. However, after new samplings of this species and examination of historical collection specimens, combined with molecular phylogenetic results based on two mitochondrial gene fragments (*CO1* and *Cyt b*) and morphological comparisons of different populations, we found distinct divergences among them. Based on these results, we made the following taxonomic decisions and described the taxa in detail: (1) the populations from the type locality and adjacent areas such as Zhejiang, Anhui, and northeastern Jiangxi were considered *Plagiopholis styani* sensu stricto; (2) the population from Hunan Province is herein described as a new species, *Plagiopholis acuta* **sp. nov.**; (3) the populations from Sichuan and Guizhou provinces are also described herein as a new species, *Plagiopholis pluvialis* **sp. nov.** This study brings the total number of *Plagiopholis* to six and highlights the importance of documenting the cryptic diversity of small-bodied snakes in East Asia's fragmented montane ecosystems.

Key Words

Chinese mountain snake, classification, *Plagiopholis styani* complex, redescription, West China rain zone

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Introduction

The genus *Plagiopholis* Boulenger, 1893, comprises a group of small, terrestrial, non-venomous colubrid snakes within the family Pseudoxenodontidae, distributed from the central and northern parts of the Indochinese Peninsula to eastern and southwestern China (Zhao 2006; Uetz et al. 2025). Due to their hidden habits and conservative morphology, taxonomic research on this genus has been limited. It was not until 2015 that Zhong et al. conducted a revisionary study on *P. unipostocularis* Zhao & Huang, 1979, designating it as a synonym of *P. blakewayi* Boulenger, 1893. Currently, four *Plagiopholis* species are recognized: *P. blakewayi*, *P. nuchalis* (Boulenger, 1893), *P. styani* (Boulenger, 1899), and *P. delacouri* Angel, 1929.

In recent years, numerous new distribution records of *P. styani* have emerged, significantly expanding its known range. Initially documented in China—Anhui, Fujian, Gansu, Guangxi, Hunan, Jiangxi, Sichuan, and Zhejiang (Zhao 2006)—its distribution was newly supplemented by records from Chongqing (Luo et al. 2004), Taiwan (Hsiang et al. 2009), Hubei (Dai et al. 2009), and Guizhou (Zhang et al. 2020). It was also discovered in Vietnam (Uetz et al. 2025) (Fig. 1). These findings have established *P. styani* as the most widely distributed species within *Plagiopholis*.

Since 2020, extensive field surveys in Sichuan, Guizhou, Hunan, Zhejiang, Jiangxi, and Fujian provinces have yielded numerous specimens morphologically resembling this species. Initial morphological comparisons, however, revealed striking discrepancies in scalation patterns and coloration. Subsequent molecular phylogenetic analyses, incorporating mitochondrial *CO1* and *Cytb* gene fragments, showed differences among these populations compared to the topotypes of *P. styani*, which was also reported by Liu et al. (2025). Notably, specimens from Sichuan and Guizhou formed a distinct clade, while those from Hunan also formed a distinct clade.

Here, we integrate morphological and molecular evidence to redescribe *Plagiopholis styani* and formally describe two new *Plagiopholis* species.

Material and methods

Morphological comparison

A total of 41 specimens of the *Plagiopholis styani* complex (15 females, 23 males, and 3 juveniles of unknown sex) from Sichuan, Jiangxi, Guizhou, Hunan, Zhejiang, and Fujian were examined morphologically. For comparison, seven topotypes and two syntypes of *P. styani* were examined (Table 1). Data from published papers (Boulenger 1893, 1899; Stejneger 1925; Angel 1929; Pope 1929, 1935; Ding and Zheng 1974; Zhao et al. 1978; Li 1994; Zhao et al. 1998; Zhao 2006) were also included in the study.

Museum abbreviations: **CIB**: Museum of Herpetology, Chengdu Institute of Biology, Chinese Academy of Sciences, Chengdu, China; **BMNH**: British Museum of Natural History, London, UK; **FJNU**: Biological Museum, Fujian Normal University, Fuzhou, China; **SYS r**: Museum of Biology (Reptile), Sun Yat-sen University, Guangzhou, China; **USNM**: United States National Museum, Washington, USA; **QHU**: Qinghai University, Xining, China; **ZJFRR**: Zhejiang Forest Resource Monitoring Center Museum (Reptile), Hangzhou, China; **FMAEM**: Forestry Management Agency of Mount Emei, Emeishan, China; **WYS**: Jiangxi Wuyishan National Nature Reserve Administration Bureau, Shangrao, China.

Morphological characters followed Boulenger (1899), Zhao et al. (1998), Zhao (2006), and Darko et al. (2022) and were recorded as follows:

Measurements (mm, complete adults only): snout-vent length (**SVL**): measured from the tip of the snout to the vent; tail length (**TAL**): measured from the vent to the tip of the tail; total length (**TL**): sum of snout–vent length and tail length; head length (**HL**): measured from the tip of the snout to the posterior margin of the mandible; head width (**HW**): maximum head width; head height (**HH**): vertical height between dorsal and ventral surfaces of head; snout length (**ESD**): distance between the tip of the snout and anterior edge of left eye; eye diameter (**ED**): horizontal diameter of left eye. We also calculated the ratio of tail length to total length (**TAL/TL**), the ratio of tail length to snout-vent length (**TAL/SVL**), the ratio of head weight to head length (**HW/HL**).

Scale counts (adults only): preocular (**PRO**): number of scales touching prior side of the orbit; postocular (**PO**): number of scales touching posterior side of the orbit; loreal (**Lor**): Number of loreal scales; supralabials (**SL**): scales behind the rostral shield and counted on upper lips; infralabials (**IL**): scales behind the mental shield and counted on lower lips; chin-shield (**Chin**); temporal (**TEMP**): Temporal scales; dorsal scale rows (**DSR**): counted at one head length behind head, at midbody, and at one head length before vent; ventral scales (**VEN**): counted from the first ventral scale, which is wider than long, to the vent excluding cloacal plate; subcaudal scales (**SC**): number of subcaudal scales excluding the terminal scute and cloacal plate (**CP**). In addition, we also counted the number of maxillary teeth (**MT**).

Coloration: Coloration was based on photographs of living and preserved specimens. We focused on two diagnostic color pattern characteristics: nuchal blotch morphology (**NB**)—anterior and posterior edge shape—and dorsal surface coloration (**DSC**).

Molecular data and phylogenetic analysis

Total genomic DNA was extracted using the Vazyme FastPure Blood/Cell/Tissue/Bacteria DNA Isolation Mini Kit (Vazyme Biotech Co., Ltd., Nanjing, China) from liver tissue samples of each specimen. Two mitochondrial gene fragments, the partial cytochrome c oxidase subunit 1 gene (*CO1*) and cytochrome b gene (*Cytb*), were concatenated for phylogenetic analysis. For polymerase chain reaction (PCR), *CO1* was amplified with primers Chmf4 and Chmr4 (Che et al. 2011), and *Cytb* was amplified with

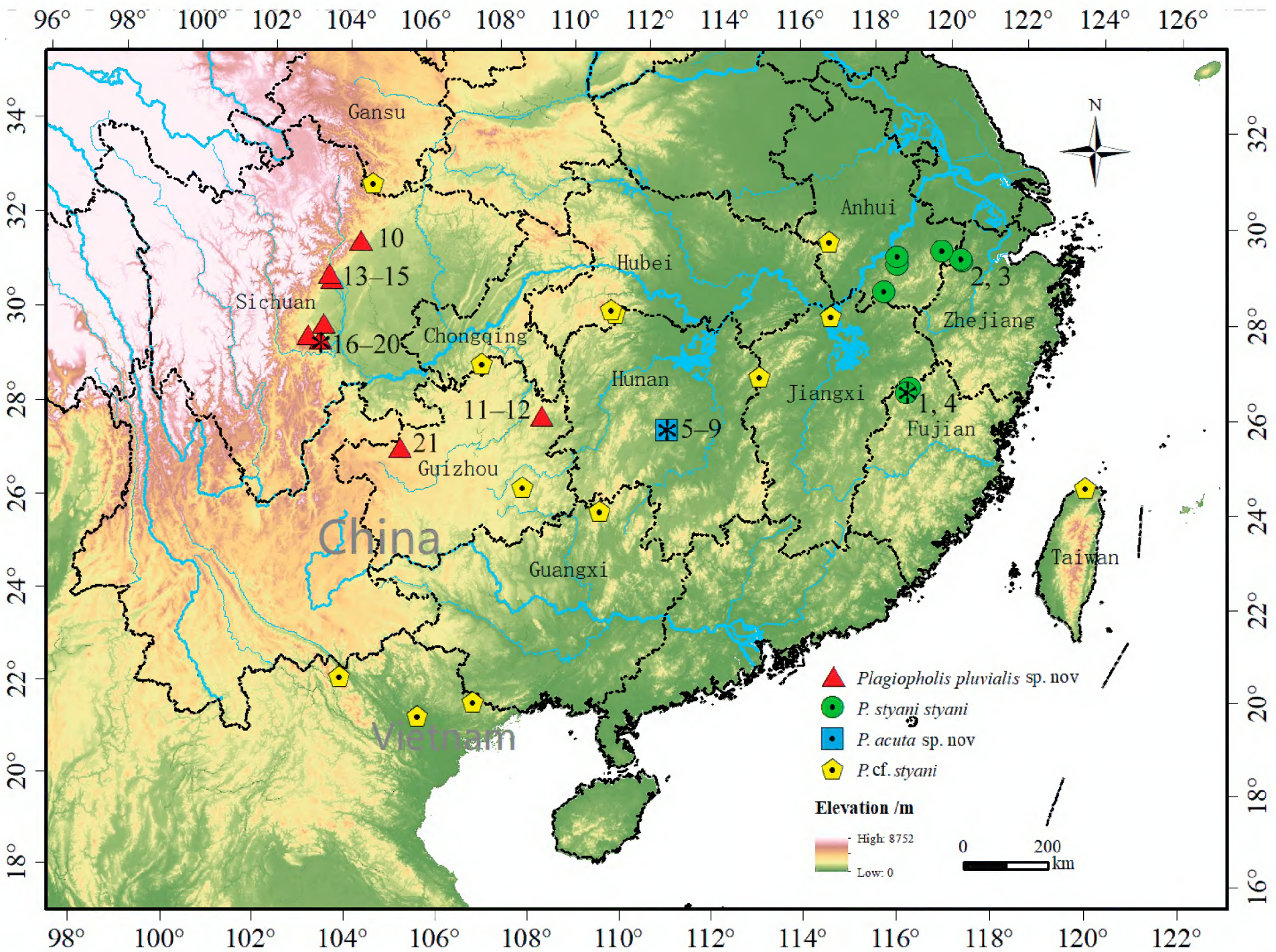

Figure 1. Distribution of the species in *Plagiopholis styani* and its congeners: Red triangle: *P. pluvialis* sp. nov.; green circle: *P. styani*; blue square: *P. acuta* sp. nov.; yellow pentagon: *P.* cf. *styani*. *: type locality; numbers near the patterns: species No. in Table 1.

primers L14919 and H16064 (Burbrink et al. 2000). The PCR was performed in 25 µl reactions with the following cycling conditions (*CO1*/*Cytb*, respectively): initial denaturing at 95 °C for 4/4 min; 35 cycles of denaturing at 95 °C for 40 s, annealing at 53/48 °C for 40/60 s, and extension at 72 °C for 60/70 s; and a final extension at 72 °C for 10 min. PCR products were sequenced by Beijing Qingke New Industry Biotechnology Co., Ltd.

Pseudoxenodon macrops (Blyth, 1855) was selected as the outgroup (Li et al. 2020), and all sequences were obtained from this study or GenBank (Table 1). We input the *CO1* (607 bp) and *Cytb* (1028 bp) sequences into MEGA11 (Tamura et al. 2021) and aligned them using MUSCLE (Edgar 2004). Uncorrected pairwise distances (p-distance) were calculated in MEGA11 for each sequence fragment. The two gene fragments were then concatenated (1635 bp) for phylogenetic reconstruction. Maximum Likelihood (ML) analysis was conducted in IQ-TREE v. 1.6.12 (Nguyen et al. 2015) under the best-fit model TPM2+F+G4, and Bayesian Inference (BI) analysis was performed in MrBayes (Ronquist et al. 2012) using a four-chain run of 10 million generations under the best-fit model HKY+F+G4. The best models were selected using ModelFinder for both IQ-TREE and MrBayes analyses (Kalyaanamoorthy et al. 2017). Sampling occurred every 1000 generations, with the first 25% discarded as burn-in. Nodal support with Bayesian posterior probabilities (BI, %) ≥ 95 was considered significant.

Results

Morphological results

All three populations lack a loreal scale (rarely present), have six supralabials with the third and fourth entering the eye, 15–15–15 dorsal scale rows, and an entire anal scale.

However, the population from Sichuan and Guizhou is characterized by a narrow, inverted V-shaped black-brown neck blotch spanning 2–3 dorsal scale rows, an olive dorsum with gold- and black-edged scales forming a reticulated pattern, smooth dorsal scales in 15–15–15 rows, fewer ventral scales (102–110 in males, 114–122 in females), 18 maxillary teeth in males, and a hemipenis with spinules distributed throughout the truncus. In contrast, *P. styani* exhibits a broad pentagonal or sub-annular neck blotch covering 4–6 dorsal scale rows, a brick-red dorsum with black-edged scales, a smooth hemipenis truncus, a higher maxillary tooth count (20–21 in males, ~18 in females), and moderate tail length ratios (mean TAL/SVL 0.16 in males, 0.14 in females). The population from Hunan Province shares the brick-red dorsum of *P. styani* but has a spinulate hemipenis truncus, intermediate maxillary tooth counts (17–18 in males, 15–17 in females), relatively longer tails in males (mean TAL/SVL 0.19), and shorter tails in females (mean TAL/SVL 0.12).

Table 1. Genetic information on the specimens used in this study.

No.	Species	Voucher number	Locality	*CO1*	*Cytb*	Reference
1	*Plagiopholis styani*	CIB WYS2024001	China, Jiangxi, Yanshan	PV335147	PV340620	This study
2	*Plagiopholis styani*	ZJFRR 202407001	China, Zhejiang, Huzhou	PV335148	PV340621	This study
3	*Plagiopholis styani*	ZJFRR 202207001	China, Zhejiang, Hangzhou	PV335149	PV340622	This study
4	*Plagiopholis styani*	KIZ 20180002	China, Fujian, Guadun	PV847831	PV833807	Liu et al. 2025
5	*Plagiopholis acuta* sp. nov.	QHU 2024009	China, Hunan, Xinshao	PV335150	PV340623	This study
6	*Plagiopholis acuta* sp. nov.	QHU 2024010	China, Hunan, Xinshao	PV335151	PV340624	This study
7	*Plagiopholis acuta* sp. nov.	QHU 2024011	China, Hunan, Xinshao	PV335152	PV340625	This study
8	*Plagiopholis acuta* sp. nov.	QHU 2024012	China, Hunan, Xinshao	PV335153	PV340626	This study
9	*Plagiopholis acuta* sp. nov.	QHU 2024044	China, Hunan, Xinshao	PV335154	PV340627	This study
10	*Plagiopholis pluvialis* sp. nov.	GP 833	China, Sichuan, Anzhou	–	KT199000	Zhong et al. 2015
11	*Plagiopholis pluvialis* sp. nov.	GP 1397	China, Guizhou, Tongren	–	KT199001	Zhong et al. 2015
12	*Plagiopholis pluvialis* sp. nov.	GP 2947	China, Guizhou, Tongren	–	KT199002	Zhong et al. 2015
13	*Plagiopholis pluvialis* sp. nov.	QHU 2024006	China, Sichuan, Dujiangyan	PV335155	PV340628	This study
14	*Plagiopholis pluvialis* sp. nov.	QHU 2024007	China, Sichuan, Wenchuan	PV335156	PV340629	This study
15	*Plagiopholis pluvialis* sp. nov.	CIB XMG2023001	China, Sichuan, Dujiangyan	PV335157	PV340630	This study
16	*Plagiopholis pluvialis* sp. nov.	CIB CB2024EMS001	China, Sichuan, Emeishan	PV335158	–	This study
17	*Plagiopholis pluvialis* sp. nov.	CIB SCC408	China, Sichuan, Emeishan	–	PV340631	This study
18	*Plagiopholis pluvialis* sp. nov.	CIB 119370	China, Sichuan, Emeishan	PV335159	PV340632	This study
19	*Plagiopholis pluvialis* sp. nov.	CIB-EMS 202016	China, Sichuan, Emeishan	PV335160	PV340633	This study
20	*Plagiopholis pluvialis* sp. nov.	CIB-EMS 202017	China, Sichuan, Emeishan	PV335161	PV340634	This study
21	*Plagiopholis pluvialis* sp. nov.	SYS r002035	China, Guizhou, Bijie	PV335162	PV340635	This study
22	*Plagiopholis blakewayi*	GP 3318	China, Yunnan, Mengzi	–	KT199004	Zhong et al. 2015
23	*Plagiopholis blakewayi*	GP 3554	China, Yunnan, Mengzi	–	KT199006	Zhong et al. 2015
24	*Plagiopholis blakewayi*	GP 3558	China, Yunnan, Mengzi	–	KT199010	Zhong et al. 2015
25	*Plagiopholis blakewayi*	GP 3938	China, Yunnan, Mengzi	–	KT199013	Zhong et al. 2015
26	*Plagiopholis blakewayi*	SYS r002136	China, Yunnan, Wenshan	–	PV340636	This study
27	*Plagiopholis blakewayi*	SYS r002207	China, Yunnan, Yanbian	PV335163	PV340637	This study
28	*Plagiopholis nuchalis*	QHU 2024045	China, Yunnan, Xishuangbanna	PV335164	PV340638	This study
29	*Plagiopholis nuchalis*	MS 853	China, Yunnan, Simao	PV335165	PV340639	This study
30	*Pseudoxenodon macrops*	CHS 218	China	MK064690	MK201345	Li et al. 2020

Molecular results

Plagiopholis styani sensu lato is resolved into three distinct and genetically divergent lineages (Fig. 2). The first lineage (green), comprising the topotypic specimen together with samples from Jiangxi and Zhejiang, represents *P. styani* sensu stricto. The second lineage (blue), formed by the Hunan population, is recovered as the sister group to *P. styani* sensu stricto, although with only moderate nodal support (SH 79 / UFB 78 / BI 100). Genetic distances between *P. styani* sensu stricto and the Hunan lineage are 4.6–5.4% for *CO1* and 5.8–6.0% for *Cytb* (Table 2).

The third lineage, consisting of the Sichuan-Guizhou population, is placed outside the clade formed by the two aforementioned lineages. It differs from *P. styani* sensu stricto by 7.2–7.6% (*CO1*) and 8.1–9.0% (*Cytb*), and from the Hunan lineage by 7.3–8.2% (*CO1*) and 8.9–9.3% (*Cytb*). By comparison, genetic divergence within each population is very small, with *CO1* distances of 0.0–0.3% in *P. styani* sensu stricto, 0.0–0.7% in the Hunan population, and 0.0–1.3% in the Sichuan-Guizhou population, and *Cytb* distances of 0.0–0.5%, 0.0–0.2%, and 0.0–2.0%, respectively (Table 2). Therefore, based on the combined morphological and molecular evidence, we herein describe the Hunan and Sichuan-Guizhou populations, which represent two previously unrecognized lineages, as two new species.

Taxonomy accounts

Plagiopholis styani (Boulenger, 1899)

Synonym. *Trirhinopholis styani* Boulenger 1899: 159

Plagiopholis styani (Boulenger, 1899)

Chinese Mountain Snake/福建颈斑蛇(Fú Jiàn Jǐng Bān Shé)

Note. G. A. Boulenger described *Plagiopholis styani* in 1899, based on two specimens, BMNH 1946.1.14.11-12 (Boulenger 1899), but did not designate a holotype. Therefore, we designate the adult male specimen, BMNH 1946.1.14.11, as the lectotype and the specimen BMNH 1946.1.14.12 as the paralectotype due to it being a juvenile and the morphological characters not being stable.

Lectotype. BMNH 1946.1.14.11, adult male, collected by J. D. La Touche, from Kuatun (= Guadun Village, Wuyishan City), Fukien (= Fujian Province), China (Fig. 3).

Paralectotype. BMNH 1946.1.14.12, juvenile female, with the same collection information as the lectotype.

Referred specimens (n = 9): CIB 10194 (field number 64I6669, adult male), FJNU 3625004 (adult male), FJNU SR (adult male), FJNU 3625005 (adult female), FJNU 3525002 (adult female), FJNU3625006 (adult female) from Wuyishan City, Fujian Province, China; WYS 2024001 (adult male) from Mt. Huanggang (the main peak

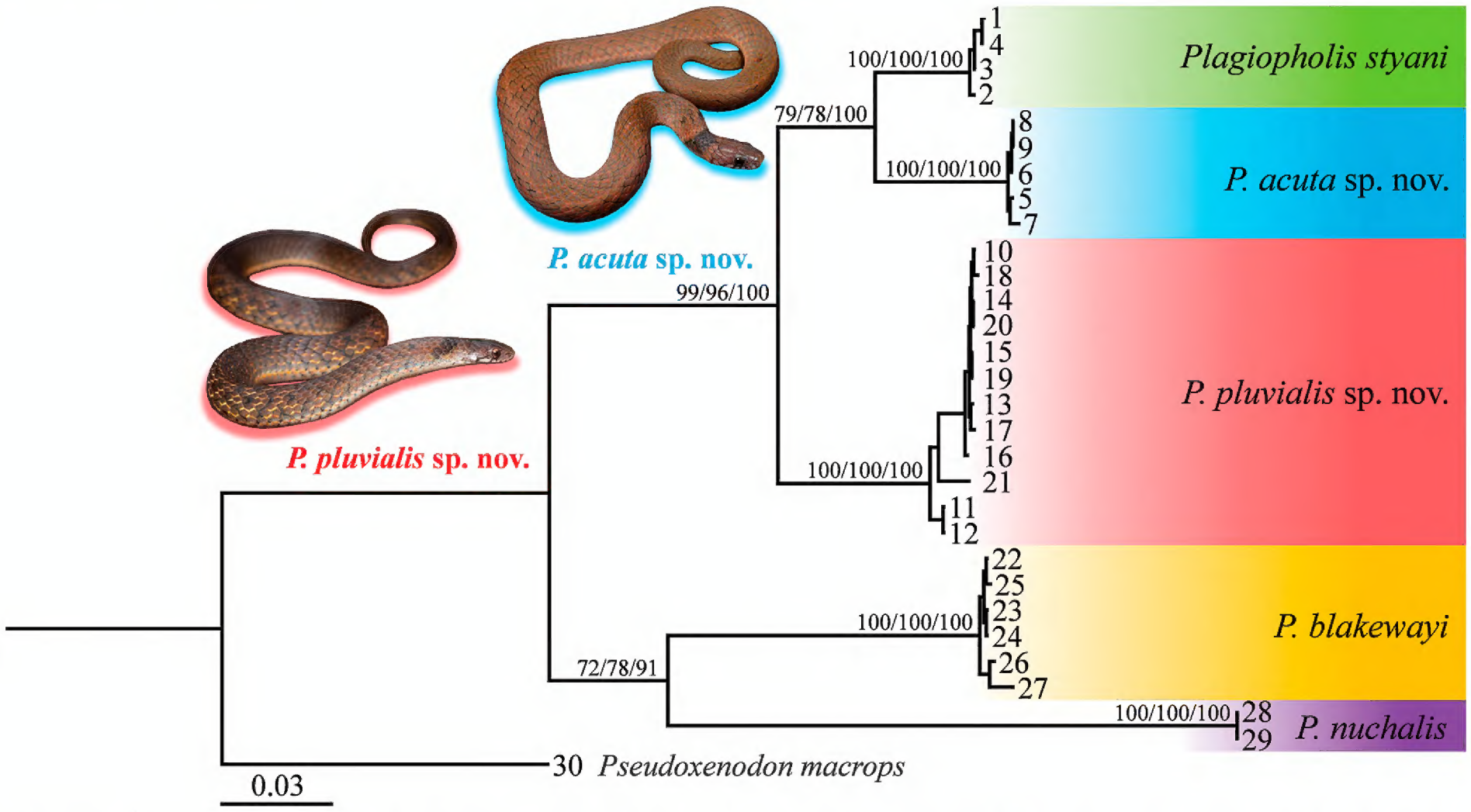

Figure 2. Phylogenetic topology based upon two mitochondrial (*CO1*/*Cyt b*) fragments. The nodes supporting values on branches are presented as the SH-like approximate likelihood ratio test/ultrafast bootstrap approximation/Bayesian posterior probabilities (SH %/UFB %/BI %); the ones lower than 50 are displayed as "–". Numbers at the tips of branches correspond to the ID numbers in Table 1. Photos on thumbnails by Yuhao Xu (*P. acuta* sp. nov.) and Tianyou Zhang (*P. pluvialis* sp. nov.).

Table 2. Uncorrected *p*-distances (%) of the *Plagiopholis* species based on the mitochondrial *CO1*/*Cytb* gene sequence fragments.

	1–4	5–9	10–21	22–27	28–29
1–4 *Plagiopholis styani*	0–0.3/0–0.5				
5–9 *Plagiopholis acuta* sp. nov.	4.6–5.4/5.8–6.0	0–0.7/0–0.2			
10–21 *Plagiopholis pluvialis* sp. nov.	7.2–7.6/8.1–9.0	7.3–8.2/8.9–9.3	0–1.3/0–2.0		
22–27 *Plagiopholis blakewayi*	13.2–13.5/13.5–14.3	13.7–14.2/15.2–16.0	13.6–13.8/13.6–14.4	0/0–0.9	
28–29 *Plagiopholis nuchalis*	14.7–15.0/15.8–16.9	15.2–15.5/15.9–16.6	15.3–16.1/15.9–16.8	13.2/15.5–16.4	0/0

of the Wuyi Mountains), Yanshan County, Jiangxi Province, China; ZJFRR 202207001 (subadult male) from Anji County, Zhejiang Province, China; and ZJFRR 202407001 (adult female) from Lin'an District, Zhejiang Province, China.

Diagnosis. *Plagiopholis styani* can be distinguished from other species within *Plagiopholis* by the combination of the following morphological characters: (1) no loreal (rarely 1), posterior nasal forming a suture with the single preocular; (2) two postoculars; (3) temporals 2+2 (rarely 2+1); (4) 6 (rarely 7) supralabials, the 3rd and 4th entering the eye; (5) 6 (rarely 5) infralabials; (6) maxillary teeth 20–21 in males and around 18 in females; (7) dorsal scale smooth and rows 15-15-15; (8) ventral scales 114–121 in males and 116–122 in females; (9) anal entire; (10) subcaudal scales, 26–30 in males and 23–28 in females; (11) longer tail 42.36–51 mm (mean 45.42 mm) in males and shorter tail 32.6–44.15 mm (mean 40.59 mm) in females; (12) higher TAL/SVL ratio of 0.15–0.17 (mean 0.16) in males and smaller TAL/SVL ratio of 0.12–0.15 (mean 0.14) in females; (13) hemipenis half divided, bilaterally symmetrical, the truncus smooth throughout with almost no spinules; (14) a wide, black-brown blotch is present on the neck, often pentagonal, sub-annular, or sagittate-shaped, across 3–6 dorsal scale rows; (15) dorsal surface of the body is brick-red, with some dorsal scale edges black, forming a faint reticulated pattern.

Redescription of the lectotype. ***Measurements and scalation.*** An adult male with TL 347 mm (SVL 303 mm and TAL 44 mm); tail relatively short, TAL/TL ratio of 0.13, and TAL/SVL ratio of 0.15; body slender and small; head slightly distinct from the neck; HW 8.46 mm; HL 12.41 mm; eye moderate, ED 2.49 mm; rostrum triangular, wider than high, slightly visible from above; internasals and prefrontals paired; frontal haxagonal, longer than wide, a little shorter than the parietals; PRO 1/1, PO 2/2; loreal absent; TEMP 4, arranged in two rows (2+2/2+2); SL 6/6, the 3rd and 4th entering the eye, the 5th and 6th largest; 2 pairs of chin-shields; IL 5/6, the 1st to 3rd touching the first pair of chin shields. DSR 15-15-15, all smooth, including the outermost row on both sides; VS 114, SC 27, CP entire.

Coloration and pattern. The dorsal surface of the head is reddish-brown, scattered with small black spots. The labial scales are light yellow with black edges on both sides. A blackish-brown subpentagonal blotch is present on the neck, pointing toward the head, and the widest part across four dorsal scale rows. Dorsal surface of the body

Figure 3. Preserved specimen of the lectotype of *Plagiopholis styani* (NHMUK 1946.1.14.11, adult male). Photos by Gernot Vogel. Scale bars are not shown.

is reddish-brown, with some dorsal scale edges outlined in black, forming a subtle reticulated pattern. Ventral and subcaudal scales are light yellow, with small dark brown spots on both sides (Fig. 3).

Head scalation. SL 6/6 (rarely 7), IL 6 (rarely 5); loreal absent or rarely present (1/12 specimens); PRO 1, PO 2; TEMP 2+2, rarely 2+1 (1/12 specimens).

Dentition. Based on two male specimens (CIB 10194 and ZJFRR 202207001) and one female specimen (ZJFRR 202407001) examined in this study and Pope (1935). Maxillary teeth 20–21 in males and 18 in females, without diastema; except for the first 2–4 being smaller, the rest are nearly equal in size.

Body scalation. DSR 15-15-15, all smooth, including the outermost row; VS 114–121 in males, and 116–122 in females; SC 26–30 in males, and 23–28 in females; CP entire.

Coloration in life. In life, the dorsal surface of the head is deep reddish-brown, sometimes scattered with small black-brown spots. The labial scales are creamy-white with black edges on both sides. A wide black-brown blotch is present on the neck, often pentagonal or irregularly ring-shaped, across 4 to 6 dorsal scale rows. Dorsal surface of the body brick-red, with some dorsal scale edges black, forming a faint reticulated pattern. The ventral and subcaudal scales range from creamy white to pale yellow, sometimes with small dark brown spots along the sides (Fig. 4).

Coloration in preservation. In preservation, the coloration still resembles the specimen in life, except that the coloration of dorsum further deepens, and the background color of the venter becomes uniform pale yellow (Figs 3, 5).

Figure 4. *Plagiopholis styani* (adult male, unvouchered) in life, from Lin'an District, Zhejiang Province, China. Photos by Yiji Su.

***Hemipenis*.** Description based on the everted left organ of the subadult male specimen ZJFRR 202207001 (Fig. 6). When fully everted, the hemipenis is Y-shaped, bilaterally symmetrical, extends to SC 8, and bifurcates at lower 4/7.

Truncus is smooth, with almost no visible spinules; the spine ornamentation starts at the base of each branch. On the asulcate surface, each branch has a well-developed, calcareous basal hook, and the upper part with dense, medium-sized spines. The spines gradually decrease in size distally, reaching nearly half of the branches, then merging into thorny calyces. The calyx area extends to the distal end of each branch. Sulcate surface is similar to the asulcate surface, except for the absence of basal hook. The sulcus spermaticus is divided, extending centrifugally to the tip of each branch, and the sulcus lips are visible and slightly raised.

Variation. See Table 3 and Figs 3–5 for the details. The longest known male specimen has a TL of 353 mm (WYS 2024001; SVL 302 mm, TAL 51 mm), and the longest known female has a TL of 406 mm (KIZ 20180002; SVL 359 mm, TAL 47 mm). Tail relatively short, TAL/SVL ratio of 0.15–0.17 (mean 0.16) in males and 0.12–0.15 (mean 0.14) in females.

Distribution and natural history. *Plagiopholis styani* have been found in Lin'an District of Hangzhou City, Anji County of Huzhou City in Zhejiang Province, and the Wuyi Mountains at the border of Fujian and Jiangxi Provinces (data corrected based on the results of the present study). According to the morphological data recorded in literature, distribution records from southern Anhui and northern Jiangxi Province might also belong to this species (Pope 1934; Chen 1991; Zhao et al. 1998; Zhao 2006). These regions are part of the mid-subtropical monsoon climate zone, characterized by distinct four seasons, warm and humid conditions (Zheng et al. 2013). This species is oviparous and distributed within an altitude range of 520–1359 m. They are commonly found in mid-subtropical evergreen broad-leaved forests and bamboo forests in this altitude range.

Pope (1929, 1935) documented the Fukien (now Fujian Province) population (*Plagiopholis styani*) to be found in the high forests and bamboo groves in the region of the type locality, which is consistent with our findings. He documented the stomachs of three Chungan Hsien

Figure 5. Preserved specimen of the topotype of *Plagiopholis styani* (CIB WYS2024001, adult male). Photos by Bo Cai. Scale bars: 10 mm.

(now Wuyishan City) specimens (*P. styani*), which contained a lot of gritty dirt suggestive of an earthworm diet. In addition, he recorded a female containing seven eggs, one of which measured 15.5 × 5.5 mm. Based on this observation, the species is inferred to be oviparous.

Plagiopholis acuta Xu, Ma, & Cai, sp. nov.

https://zoobank.org/36E77EE4-7401-4278-A496-2A78DCDDBA2F

Holotype. QHU 2024009, adult male, collected by the team of Lifang Peng in August 2024 from Xinshao County, Shaoyang City, Hunan Province, China (27.4533°N, 111.7558°E, 530 m a.s.l.)

Paratypes. QHU 2024010 (adult female), QHU 2024011 (adult male), with the same collected information as the holotype; QHU 2024044 (adult female) collected by the team of Lifang Peng in October 2024, from the same locality as the holotype.

Other material examined. QHU 2024012, juvenile, an offspring hatched in captivity on 16 September, 2024, from the egg laid by the female specimen QHU 2024010.

Diagnosis. *Plagiopholis acuta* sp. nov. can be differentiated from other taxa in the genus *Plagiopholis* by the following combination: (1) no loreal, posterior nasal forming a suture with the single preocular; (2) two postoculars; (3) temporals 2+2 (rarely 2+1); (4) 6 (rarely 7) supralabials, the 3rd and 4th entering the eye; (5) 6 (rarely

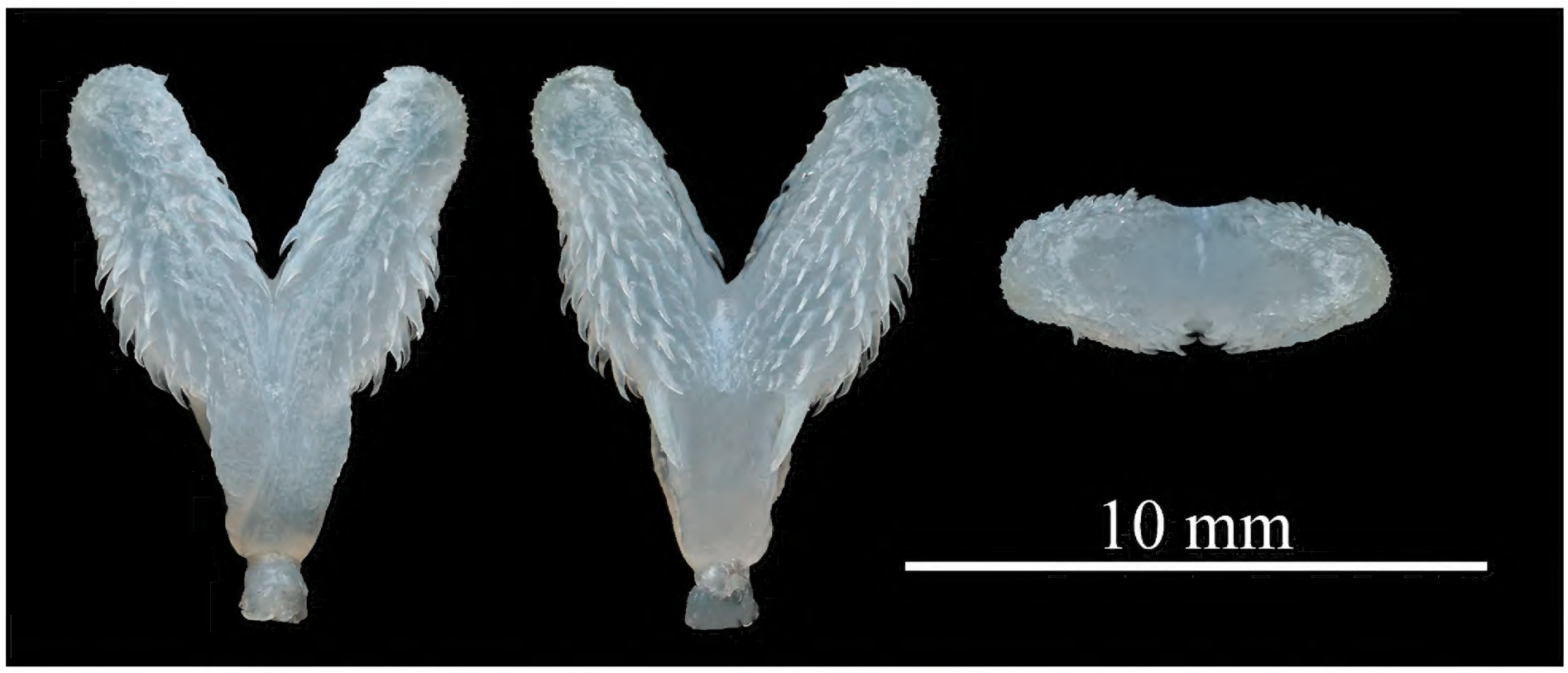

Figure 6. Hemipenis of *Plagiopholis styani* (ZJFRR 2022001, subadult male). Photos by Yuhao Xu. Scale bars: 10 mm.

5) infralabials; (6) maxillary teeth 17–18 in males and 15–17 in females; (7) dorsal scale smooth and rows 15-15-15; (8) ventral scales 114–115 in males and 115–121 in females; (9) anal entire; (10) subcaudal scales 29–30 in males and 24–25 in females; (11) longer tail length of 51–52 mm (mean 51.5 mm) in males and shorter tail length of 25–43 mm (mean 34 mm) in females; (12) larger TAL/SVL ratio of 0.18–0.19 (mean 0.19) in males and lower TAL/SVL ratio of 0.11–0.14 (mean 0.12) in females; (13) hemipenis half divided, bilaterally symmetrical, the truncus spinulate throughout; (14) a wide, black-brown blotch is present on the neck, often pentagonal or sub-annular shaped, across 4–6 dorsal scale rows; (15) dorsal surface of the body is brick-red, with some dorsal scale edges black, forming a faint reticulated pattern.

Description of the holotype. ***Measurements and scalation.*** An adult male with TL 313 mm (SVL 262 mm and TAL 51 mm); tail relatively short, TAL/TL ratio of 0.16, and TAL/SVL ratio of 0.19; body slender and small; head slightly distinct from the neck, HL 12.8 mm, HW 7.8 mm, HH 6.0 mm; eye moderate, ED 2.12 mm; rostrum triangular, wider than high, slightly visible from above; snout relatively short, ESD 3.7 mm; internasals and prefrontals paired; frontal haxagonal, longer than wide, a little shorter than the parietals; PRO 1/1, PO 2/2; loreal absent; TEMP 4, arranged in two rows (2+2/2+2); SL 6/6, the 3rd and 4th entering the eye, the 5th and 6th largest; chin shields in 2 pairs, the anterior pair longer than posterior one and in contact with the mental; IL 6/6, the 1st to 3rd touching the first pair of chin shields. DSR 15-15-15, all smooth, including the outermost row on both sides; VS 115, SC 30, CP entire.

Dentition. Maxillary teeth 18/17, without diastema; except for the first 3 being smaller, the rest are nearly equal in size.

Coloration in life. In life, dorsal surface of the head is deep reddish-brown, with small black-brown spots scattered along the sides; the supralabials are creamy-white with black edges on both sides. Ventral surface of head cream-white, the edges of partial scales have irregular black-brown patches. A wide, black-brown collar is present on the neck, across 5 dorsal scale rows. Dorsal surface of the body is brick-red, with some dorsal scale edges black, forming a faint reticulated pattern. The ventral and subcaudal scales uniform pale yellow (Fig. 7).

Coloration in preservation. In preservation, the coloration still resembles the specimen in life, except that the coloration of dorsum further deepens, and the ventral surface of head becomes pale yellow (Figs 8, 9).

Variation. The main morphological characters of *Plagiopholis acuta* sp. nov. are listed in Table 4. The paratypes exhibit a similar morphological pattern as the holotype, but there is a pronounced sexual dimorphism: compared to females, the examined males have a significantly longer tail, TAL/TL ratio of 0.15–0.16 and TAL/SVL ratio of 0.18–0.19 (vs. TAL/TL ratio of 0.10–0.12 and TAL/SVL ratio of 0.11–0.14 in females), fewer ventrals (114–115 vs. 115–121 in females), more subcaudals (29–30 vs. 24–25 in females), and more maxillary teeth (17–18 vs. 15–17 in females).

Hemipenis. Description based on the everted left organ of the male paratype QHU 2024011 (Fig. 10). When fully everted, the hemipenis is Y-shaped, bilaterally symmetrical, extends to SC 7, and bifurcates at lower 4/7. Both sulcate and asulcate surfaces densely ornamented with spinules, spines, or calyxes. Truncus spinulate throughout, branches divided into spine and calyx areas; a well-developed, calcareous basal hook is present on the asulcate surface of each branch.

Spiny area characterized by medium-size, dense spines, gradually decrease in size distally, reaching nearly half of the branches, then merging into thorny calyces. The calyx area extends to the distal end of each branch. The sulcus spermaticus is divided, extending centrifugally to the tip of each branch, and the sulcus lips are visible and slightly raised.

Table 3. Main morphological characteristics of *Plagiopholis styani* obtained from the specimens examined in this study and Stejneger (1925). TH: truncus of the hemipenis.

Voucher Number	NHMUK 1946.1.14.11	NHMUK 1946.1.14.12	CIB 10194	FJNU 3625004	FJNU SR	USNM 66434	WYS 2024001
	lectotype	**paralectotype**	**topotype**	/	/	/	**topotype**
Source	this study	this study	this study	this study	this study	Stejneger (1925)	this study
Location	Guadun, Mt. Wuyi, Fujian	Guadun, Mt. Wuyi, Fujian	Mt. Wuyi, Fujian	Mt. Wuyi, Fujian	Mt. Wuyi, Fujian	Fuzhou, Fujian	Mt. Huanggang, Shangrao, Jiangxi
Sex	♂	J ♀	♂	♂	♂	♂	♂
SVL	303	110	257	278	271	/	302
TAL	44	14	42	43	46	/	51
TL	347	124	299	321	317	/	353
TAL/TL	0.13	0.11	0.14	0.13	0.15	/	0.14
TAL/SVL	0.15	0.13	0.16	0.16	0.17	/	0.17
HL	12.41	8.25	12.55	12.08	13.31	/	13.22
HW	8.46	5.06	7.14	8.09	9.27	/	7.32
HW/HL	0.68	0.61	0.57	0.67	0.70	/	0.55
ED	2.49	1.42	4.18	/	/	/	2.27
MT	/	/	20/20	/	/	/	/
PRO	1/1	1/1	1/1	1/1	1/1	1/1	1/1
PO	2/2	2/2	2/2	2/2	2/2	2/2	2/2
Lor	0	0	0	0	0	0	0
SL	6/6	7/7	6/6	6/6	6/6	6/6	6/6
IL	5/6	6/6	6/6	6/6	6/6	6/6	6/6
TEMP	2+2/2+2	2+2/2+2	2+2/2+2	2+1/2+1	2+2/2+2	2+2/2+2	2+2/2+2
DSR	15–15-15	15–15-15	15–15-15	15–15-15	15–15-15	15-15-15	15-15-15
VEN	114	120	118	114	114	116	121
SC	27	23	28	27	30	29	26
CP	entire	entire	entire	entire	entire	entire	entire
NB	pentagonal	subannular	sagittate	pentagonal	pentagonal	/	/
TH	smooth	/	smooth	/	/	/	/

Voucher Number	ZJFRR 202207001	KIZ 20180002	FJNU 3625005	FJNU 3525002	FJNU 3625006	ZJFRR 202407001
	/	**topotype**	/	/	/	/
Source	this study	Liu et al. 2025	this study	this study	this study	this study
Location	Lin'an, Zhejiang	Guadun, Wuyishan City, Fujian	Mt. Wuyi, Fujian	Mt. Wuyi, Fujian	Mt. Wuyi, Fujian	Anji, Zhejiang
Sex	♂	♀	♀	♀	♀	♀
SVL	215	359	300	282	298	292
TAL	18+	47	44	33	43	43
TL	233+	406	344	315	341	335
TAL/TL	/	0.12	0.13	0.10	0.13	0.13
TAL/SVL	/	0.13	0.15	0.12	0.14	0.15
HL	12	/	13.75	12.38	12.29	12.40
HW	7.1	/	9.29	7.35	7.30	7.90
HW/HL	0.59	/	0.68	0.59	0.59	0.64
ED	2.17	/	/	/	/	2.12
MT	20/20	/	/	/	/	18/18
PRO	1/1	1/1	1/1	1/1	1/1	1/1
PO	2/2	2/2	2/2	2/2	2/2	2/2
Lor	1/1	0/0	0	0	0	0
SL	6/6	6/6	6/6	6/6	6/6	6/6
IL	6/6	6/6	6/6	6/6	6/6	6/6
TEMP	2+2/2+2	2+2/2+2	2+2/2+2	2+2/2+2	2+1/2+2	2+2/2+2
DSR	15-15-15	15-15-15	15-15-15	15-15-15	15-15-15	15-15-15
VEN	118	119	118	116	122	122
SC	/	25	28	23	28	26
CP	entire	entire	entire	entire	entire	entire
NB	subannular	pentagonal	pentagonal	sagittate	pentagonal	subannular
TH	smooth	/	/	/	/	/

Etymology. The specific epithet "*acuta*" means "sharp," referring to the large, pointed basal hooks on the hemipenis of this species. Based on the type locality, Xinshao County, Hunan Province, we suggest "Hunan Mountain Snake" as its English common name and "湖南颈斑蛇 (Hú Nán Jǐng Bān Shé)" as its Chinese common name.

Figure 7. Dorsal (**A**) and ventral (**B**) views of *Plagiopholis acuta* sp. nov. in life. **A1**, **B1**. QHU 2024009, holotype, adult male; **A2**, **B2**. QHU 2024010, paratype, adult female; **A3**, **B3**. QHU 2024011, paratype, adult male. Photos by Yuhao Xu.

Distribution and natural history. Specimen QHU 2024010 was a gravid female collected on August 7, 2024, and then kept in captivity under laboratory conditions at Qinghai University. It was housed in a 60 cm × 40 cm reptile terrarium with a substrate layer of approximately 3 cm of coarse peat soil. Humidity was maintained by providing a water dish and regular misting. On 11 August, the female laid five eggs, with an average length of 21 mm. The eggs were incubated in a moist mixture of coarse vermiculite and perlite at a constant temperature of 27 °C. After five days of incubation, candling with a flashlight revealed clear signs of embryonic development in only two eggs, while the remaining three showed no visible signs of development. After one week, the undeveloped eggs became moldy and shriveled. During the remainder of the incubation period, one of the two fertilized eggs failed to develop successfully. On September 16, the other one hatched (specimen QHU 2024012), measuring approximately 92 mm in length and weighing 1 g. However, it exhibited some deformities and morphological abnormalities (Table 4, Fig. 11). The first shedding occurred on September 25, and then the snake died on September 28. Based on the feeding and incubation results, we infer that this species may be better adapted to mid-elevations below 2000 m and relatively cool environments. The observed deformities may have been caused by high-altitude conditions or elevated temperatures during transportation and incubation.

Figure 8. Preserved specimen of the holotype of *Plagiopholis acuta* sp. nov. (QHU 2024009, adult male). Photos by Yuhao Xu. Scale bars: 10 mm.

Plagiopholis acuta sp. nov. has currently only been discovered in Xinshao County of Shaoyang City, Hunan Province. This area belongs to the mid-subtropical monsoon humid climate zone, characterized by distinct four seasons, abundant sunlight and heat, plentiful rainfall, with the rainy season coinciding with the hot season (Zheng et al. 2013). This new species is most probably distributed within mid-subtropical evergreen broad-leaved forests at an altitude of 530 m.

Comparisons. *Plagiopholis acuta* sp. nov. can be separated from *P. styani* as follows: (1) fewer maxillary teeth, 17–18 in males and 15–17 in females (vs. 20–21 in males and 18 in females); (2) tail relatively longer in males, and shorter in females (TAL/SVL ratio of 0.18–0.19, mean

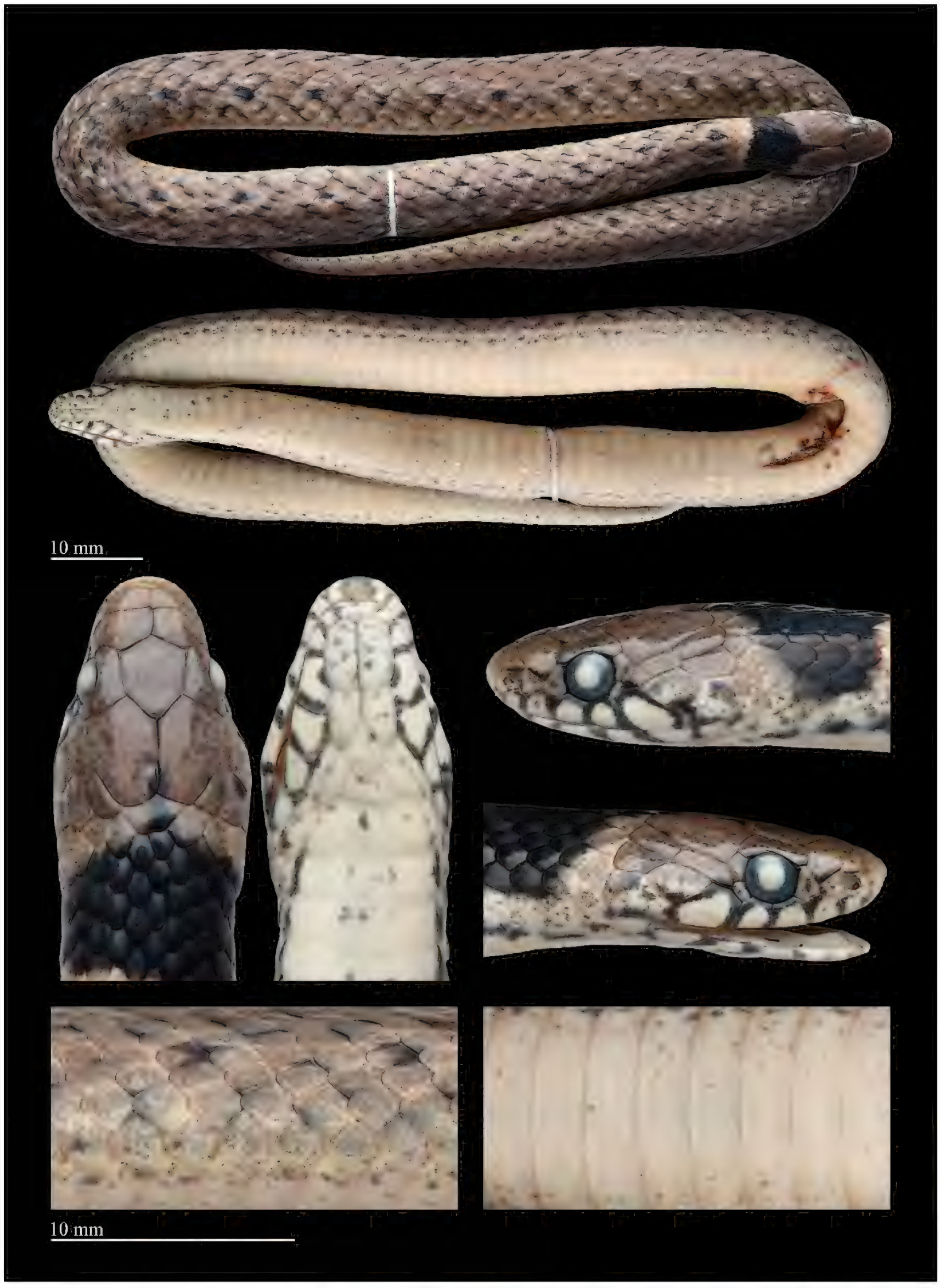

Figure 9. Preserved specimen of the paratype of *Plagiopholis acuta* sp. nov. (QHU 2024010, adult female). Photos by Yuhao Xu. Scale bars: 10 mm.

0.19 vs. 0.15–0.17, mean 0.16 in males, and 0.11–0.14, mean 0.12 vs. 0.12–0.15, mean 0.14 in females); and (3) The truncus of the hemipenis spinulate throughout (vs. smooth). A detailed comparison between the new subspecies and its congeners is summarized in Table 5.

Plagiopholis acuta sp. nov. can be easily separated from *P. blakewayi*, *P. nuchalis*, and *P. delacouri* by having TEMP 2+2 (vs. 0/1+1 in *P. blakewayi*, 1+2 in *P. nuchalis* and *P. delacouri*) and different body coloration. Moreover, it can also be separated from *P. blakewayi* due to the more supralabials (6 vs. 5); and from *P. nuchalis* due to the fewer maxillary teeth in females (15–17 vs. 20–22) and the absence of the loreal (vs. loreal present).

Table 4. Main morphological characteristics of *Plagiopholis acuta* sp. nov. obtained from the specimens examined. TH: truncus of the hemipenis.

Voucher Number	QHU 2024009	QHU 2024011	QHU 2024010	QHU 2024044	QHU 2024012
	holotype	**paratype**	**paratype**	**paratype**	/
Source	this study	this study	this study	this study	this study
Location	Xinshao, Hunan	Xinshao, Hunan	Xinshao, Hunan	Xinshao, Hunan	Xinshao, Hunan
Sex	♂	♂	♀	♀	J
SVL	262	284	233	302	79
TAL	51	52	25	43	13
TL	313.00	336.00	258.00	345.00	92.00
TAL/TL	0.16	0.15	0.10	0.12	0.14
TAL/SVL	0.19	0.18	0.11	0.14	0.16
HL	12.8	13.3	11.1	12.6	7.2
HW	7.8	7.5	7.2	8.1	4.1
HW/HL	0.61	0.56	0.65	0.64	0.57
ED	2.12	2.11	1.88	1.93	1.7
MT	18/17	17/17	15/15	15/17	/
PRO	1/1	1/1	1/1	1/1	1/1
PO	2/2	2/2	2/2	2/2	2/2
Lor	0	0	0	0	0
SL	6/6	6/6	6/6	6/6	6/6
IL	6/6	6/6	6/6	6/6	5/4
TEMP	2+2/2+2	2+2/2+2	2+2/2+2	2+2/2+2	2+2/2+2
DSR	15-15-15	15-15-15	15-15-15	15-15-15	15-15-15
VEN	115	114	115	121	101
SC	30	29	25	24	22
CP	entire	entire	entire	entire	entire
NB	subannular	pentagonal	pentagonal	subannular	subannular
TH	spinulate throughout	spinulate throughout	/	/	/

Table 5. Comparative analysis of key morphological characteristics of *Plagiopholis styani*, *P. acuta* sp. nov., and *P. pluvialis* sp. nov. obtained from the specimens examined in this study, Stejneger (1925), and Zhao et al. (1998). TH: truncus of the hemipenis.

Species	*P. styani*		*P. acuta* sp. nov.		*P. pluvialis* sp. nov.	
Sex	♂	♀	♂	♀	♂	♀
N	7	5	2	2	17	15
TAL/TL	0.13–0.15 (a 0.14)	0.10–0.13 (a 0.12)	0.15–0.16 (a 0.16)	0.10–0.12 (a 0.11)	0.12–0.18 (a 0.15)	0.11–0.13 (a 0.12)
TAL/SVL	**0.15–0.17 (a 0.16)**	**0.12–0.15 (a 0.14)**	**0.18–0.19 (a 0.19)**	**0.11–0.14 (a 0.12)**	**0.14–0.21 (a 0.18)**	**0.12–0.15 (a 0.14)**
HW/HL	0.55–0.70 (a 0.63)	0.59–0.68 (a 0.63)	0.56–0.61 (a 0.59)	0.64–0.65 (a 0.65)	0.54–0.68 (a 0.61)	0.53–0.73 (a 0.61)
MT	**20–21**	**18**	**17–18**	**15–17**	**18**	**/**
PRO	1	1	1	1	1	1
PO	2	2	2	2	2	2
Lor	0 (rarely 1)	0	0	0	0 (rarely 1)	0 (rarely 1)
SL	6	6 (rarely 7)	6	6	6	6
IL	6 (rarely 5)	6	6	6	6	6
TEMP	2+1/2	2+2	2+2	2+2	2+2	2+1/2
DSR	15-15-15	15-15-15	15-15-15	15-15-15	15-15-15	15-15-15
VEN	**114–121 (a 116.43)**	**116–122 (a 119.40)**	**114–115 (a 114.50)**	**115–121 (a 118)**	**102–110 (a 108.19)**	**114–122 (a 117.53)**
SC	26–30 (a 27.83)	23–28 (a 26.00)	29–30 (a 29.50)	24–25 (a 24.50)	26–31 (a 28.35)	16–26 (a 22.60)
CP	entire	entire	entire	entire	entire	entire
TH	**smooth**	**/**	**spinulate throughout**	**/**	**spinulate throughout**	**/**
NB	**pentagonal, subannular or sagittate-shaped, across 3–6 dorsal scale rows**		**pentagonal or subannular, across 4–6 dorsal scale rows**		**inverted "V" shaped, across 2–3 dorsal scale rows**	
DSC	**Dorsal brick-red with some scale edges black, forming a faint reticulated pattern**		**Dorsal brick-red with some scale edges black, forming a faint reticulated pattern**		**Dorsal olive with some scale edges yellow and black, forming a reticulated pattern.**	

***Plagiopholis pluvialis* Cai, Xu, & Ma, sp. nov.**

https://zoobank.org/006F06AF-28B4-4CB1-AE5A-D4FE39B6666A

Synonym. *Trirhinopholis styani* – (part: population from Sichuan) Stejneger (1925);

Plagiopholis styani – (part: population from Sichuan) Ding and Zheng (1974).

Holotype. CIB 119370 (field number EMS 202021), adult male, collected by the team of Bo Cai on 10 August 2020, from Longdong Village, Huangwan Town, Emeishan City, Sichuan Province, China (29.5798°N, 103.2937°E, 1324 m a.s.l.).

Paratypes. Males (n = 14): CIB 10176 (field number 562244), CIB 10177 (field number 55494),

Figure 10. Hemipenis of *Plagiopholis acuta* sp. nov. (QHU 2024011, adult male). Photos by Yuhao Xu. Scale bars: 10 mm.

Figure 11. The newly hatched juvenile specimen (QHU 2024012) of *Plagiopholis acuta* sp. nov.

CIB 10180 (field number 505119), CIB 10181 (field number 561771), CIB 10184 (field number 561773), CIB 10186 (field number 562156), CIB 10189 (field number 562153), CIB 10192 (field number 562171), CIB 10193 (field number 12014) were collected from Mt. Emei in Emeishan City, Sichuan Province, China; CIB 10188 (field number 715013) was collected from Hongya County. Meishan City, Sichuan Province, China; QHU 2024006 from Mt. Qingcheng, Dujiangyan City, Sichuan Province, China; CIB XMG 2023001, Dujiangyan Panda Valley, Chengdu Research Base of Giant Panda Breeding, Chengdu City, Sichuan Province, China; QHU 2024007 was collected from Anziping Village, Wenchuan County, Aba Tibetan and Qiang Autonomous Prefecture, Sichuan Province, China. **Females (n = 9)**: CIB 10178 (field number 562182), CIB 10179 (field number 562180), CIB 10182 (field number 562266), CIB 10185 (field number 561772), CIB 10187 (field number 561775), CIB 10191 (field number 562297), FMAEM were collected from Mt. Emei in Emeishan City, Sichuan Province, China; CIB CB25DY01, a roadkilled male, was collected from Dayi County in the Chengdu Section of Giant Panda National Park, Sichuan Province, China; SYS r002035 was collected from Baima Mountain Forest Farm, Bijie City, Guizhou Province. **Juveniles (N = 2)**: CIB CB2024EMS001 was collected from Mt. Emei in Emeishan City, Sichuan Province, China; CIB 10183 (field number 595027) was collected from Hongya County, Meishan City, Sichuan Province, China.

Diagnosis. *Plagiopholis pluvialis* sp. nov. can be diagnosed from other *Plagiopholis* species by the following unique combination of characters: (1) no loreal (rarely 1), posterior nasal forming a suture with the single preocular; (2) two postoculars; (3) temporals 2+2 (rarely 2+1); (4) 6 supralabials, the 3rd and 4th entering the eye; (5) 6 infralabials; (6) maxillary teeth 18 in males; (7) dorsal scale smooth and rows 15-15-15; (8) ventral scales 102–110 in males and 114–122 in females; (9) anal entire; (10) subcaudal scales 26–31 in males and 16–26 in females; (11) longer tail length 40–59 mm (mean 49 mm) in males, and shorter tail length 34–47 mm (mean 40 mm) in females; (12) larger TAL/SVL ratio of 0.14–0.21 (mean 0.18) in males and lower TAL/SVL ratio of 0.12–0.15 (mean 0.14) in females; (13) hemipenis half divided, bilaterally symmetrical, the truncus spinulate throughout; (14) a relatively narrow, black-brown blotch is present on the neck, often inverted "V" shaped, across 2–3 dorsal scale rows; (15) dorsal surface of the body is olive, with some dorsal scale edges yellow and black, forming a reticulated pattern.

Description of the holotype. ***Measurements and scalation.*** An adult male with TL 322 mm (SVL 282 mm and TAL 40 mm); tail relatively short, TAL/TL ratio of 0.12, and TAL/SVL ratio of 0.14; body slender and small; head slightly distinct from the neck, HL 11.5 mm, HW 7.6 mm, HH 5.7 mm; eye moderate, ED 2.3 mm; rostrum triangular, wider than high, slightly visible from above; snout relatively short, ESD 4.1 mm; internasals and prefrontals paired; frontal hexagonal, longer than wide, a little shorter than the parietals; PRO 1/1, PO 2/2; loreal absent; TEMP 4, arranged in two rows (2+2/2+2); SL 6/6, the 3rd and 4th entering the eye, the 6th largest; chin shields in 2 pairs, the anterior pair longer than posterior one and in contact with the mental; IL 6/6, the 1st to 3rd touching the first pair of chin shields. DSR 15-15-15, all smooth, including the outermost row on both sides; VS 108, SC 27, CP entire.

Dentition. Maxillary teeth 18, without diastema; except for the first 3 being smaller, the rest are nearly equal in size.

Coloration in life. In life, dorsal surface of the head is olive, with small black-brown spots scattered along the sides; the supralabials are wheat with broad black edges on both sides. Ventral surface of head wheat, partial scales have irregular black-brown patches. A relatively narrow, black-brown collar is present on the neck, inverted "V" shaped, across 2–3 dorsal scale rows. Dorsal surface of the body is olive, with some dorsal scale edges gold and black, forming a faint reticulated pattern. The ventral and subcaudal scales uniform wheat. (Fig. 12).

Coloration in preservation. In preservation, the coloration still resembles the specimen in life (Figs 13, 14).

Variation. The main morphological characters of *Plagiopholis pluvialis* sp. nov. are listed in Table 6. All known specimens exhibit a similar morphological pattern to the holotype, but there is pronounced sexual dimorphism: compared to females, the examined males have a significantly long tail, TAL/TL ratio of 0.12–0.18 and TAL/SVL ratio of 0.14–0.21 (vs. TAL/TL ratio of 0.11–0.13 and TAL/SVL ratio of 0.12–0.15 in females), fewer ventrals (102–110 vs. 114–122 in females), more subcaudals (26–31 vs. 16–26). Most specimens have temporals 2+2 on each side, but the left of CIB10182 (field number 562266) is 2+1. Most specimens loreal absence but the female specimen USNM 65505 in Stejneger (1925) has one loreal on each side.

Hemipenis. Description based on the everted left organ of the male paratypes QHU 2024006 and QHU 2024007 (Fig. 15). When fully everted, the hemipenis is Y-shaped, bilaterally symmetrical, extends to SC 7 in QHU 2024007 and SC 8 in QHU 2024006, bifurcates at about lower 5/9. Both sulcate and asulcate surfaces densely ornamented with spinules, spines, or calyxes. Truncus spinulate throughout, branches divided into spine and calyx areas; a well-developed, calcareous basal hook is present on the asulcate surface of each branch.

Spine area characterized by medium-sized, dense spines, gradually decrease in size distally, reaching nearly half of the branches, then merging into thorny calyces. The calyx area extends to the distal end of each branch. The sulcus spermaticus is divided, extending centrifugally to the tip of each branch, and the sulcus lips are visible and slightly raised.

Etymology. The Latin specific epithet *pluvialis* means 'related to rain' or 'rainy,' indicating that the species inhabits particularly moist environments, especially within the West China Rain Zone in China. It is suggested that the English name for this species be "Western China Mountain Snake" and the Chinese name be "华西颈斑蛇 (huá xī jǐng bān shé)".

Distribution and natural history. This species is known to be distributed in mountainous areas at altitudes of 744–1900 m at several localities, including Wenchuan County in Aba Tibetan and Qiang Autonomous Prefecture; Anzhou District in Mianyang City; Dayi County and Dujiangyan City in Chengdu City; Hongya County in Meishan City; and Emeishan City in Leshan City, all in Sichuan Province, China; as well as Qixingguan District in Bijie City and Mt. Fanjing in Tongren City, both in Guizhou Province, China (Stejneger 1925; Pope 1929, 1935; Zhao et al. 1998; Zhao 2006; Zhong et al. 2015; Liu et al. 2025, and this study). The distribution areas fall within the mid-subtropical monsoon climate zone characterized by mixed evergreen and deciduous broad-leaved forests, where four distinct seasons are observed, with hot and rainy summers and mild, less rainy winters (Zheng et al. 2013). Particularly the snake's main distribution area lies within the West China Rain Zone in Sichuan, a unique geographical region known for its significant rainfall due to the convergence of various climatic fronts, making it one of the wettest places in China.

Figure 12. *Plagiopholis pluvialis* sp. nov. in life. **A.** CIB CB2024EM001, holotype, adult male, from Mt. Emei, Sichuan Province, China; **B.** QHU 2024007, paratype, subadult male, from Wenchuan County, Sichuan Province; **C.** QHU 2024006, paratype, adult male, from Mt. Qingcheng, Sichuan Province. Photos by: Bo Cai (**A**), Yuhao Xu (**B**), and Tianyou Zhang (**C**).

Pope (1929, 1935) documented that the stomachs of two specimens from Mt. Emei had eaten an earthworm apiece and found 5, 6, and 11 eggs, respectively, in three Mt. Emei females. One of the eggs in the clutch of 5 measured 19 × 11 mm and contained a very small embryo, while the female with 11 eggs was collected in July. This new species is also certainly oviparous.

Comparisons. *Plagiopholis pluvialis* sp. nov. differs from *P. styani* and *P. acuta* sp. nov. by having the following combined characteristics: (1) a relatively narrow, black-brown blotch is present on the neck, often inverted "V" shaped, across 2–3 dorsal scale rows (vs. a wide, black-brown blotch is present on the neck, often pentagonal or irregularly semiring-shaped, across 4 to 6 dorsal scale rows in *P. styani* and *P. acuta* sp. nov.); (2) the truncus of the hemipenis spinulate throughout (vs. smooth in *P. styani*); (3) maxillary teeth 18 in males (vs. 20–21 in *P. styani* in males); (4) fewer ventral scales 102–110 in males (vs. 114–115 in *P. acuta* sp. nov. and 114–121 in *P. styani* in males); (5) the dorsal surface of the body is olive, with some dorsal scale edges gold and black (vs. brick-red, with some dorsal scale edges black in *P. styani and P. acuta* sp. nov.); (Fig. 16). A detailed comparison between the new species and its congeners is summarized in Table 5.

Figure 13. Preserved specimen of the holotype of *Plagiopholis pluvialis* sp. nov. (CIB CB2024EM001, adult male). Photos by Bo Cai. Scale bars: 10 mm.

Plagiopholis pluvialis sp. nov. can be easily separated from *P. blakewayi*, *P. nuchalis*, and *P. delacouri* by having TEMP 2+2 (vs. 0/1+1 in *P. blakewayi*, 1+2 in *P. nuchalis* and *P. delacouri*) and significantly different body coloration. Moreover, it can also be separated from *P. blakewayi* due to the more supralabials (6 vs. 5).

Discussion

Plagiopholis acuta sp. nov. and *P. pluvialis* sp. nov. represent two new species synchronously described in the genus *Plagiopholis* in 96 years. This long gap is likely due to the group's highly conservative morphology, especially in pholidosis. However, the two new species display several important diagnostic features, including ventral scale counts, hemipenial morphology, scale coloration and pattern, and the shape of the nuchal blotch. These characteristics provide valuable reference points for future taxonomic studies within the genus.

Previously, *Plagiopholis styani* was thought to be widely distributed across numerous provinces in China, as well as northern Vietnam. However, our findings suggest its actual range is far more limited, likely confined to a small area in eastern China. This species appears restricted to the mountainous regions of southern Anhui, Zhejiang, and northern Jiangxi, extending to the Wuyi Mountains along the Jiangxi–Fujian border. In contrast, *P. acuta* sp. nov. is currently known only from Xinshao County in the Central Hunan Hills, a region surrounded

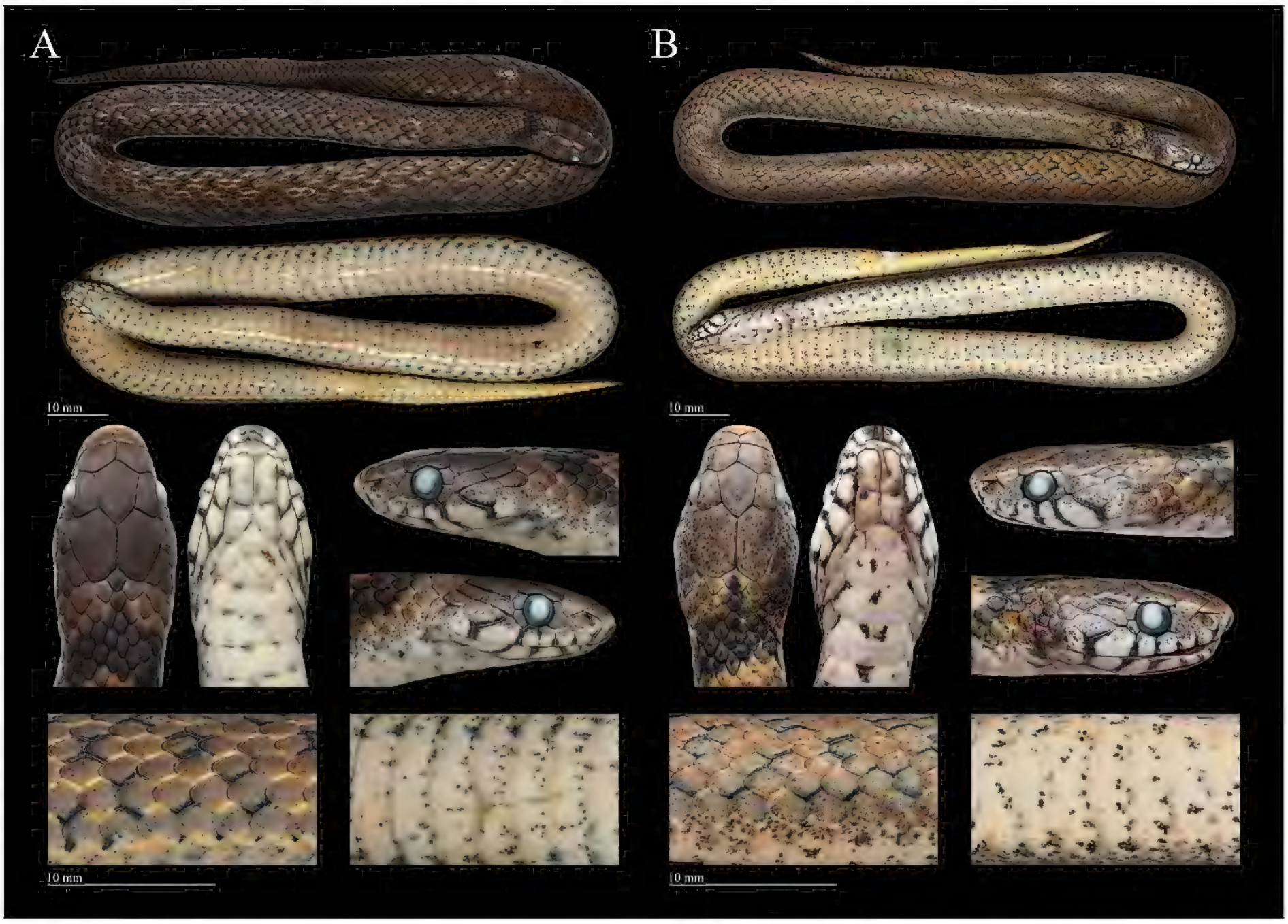

Figure 14. Preserved specimen of the paratypes of *Plagiopholis pluvialis* sp. nov. **A**. QHU 2024007, adult male; **B**. QHU 20240006, subadult male. Photos by Yuhao Xu. Scale bars: 10 mm.

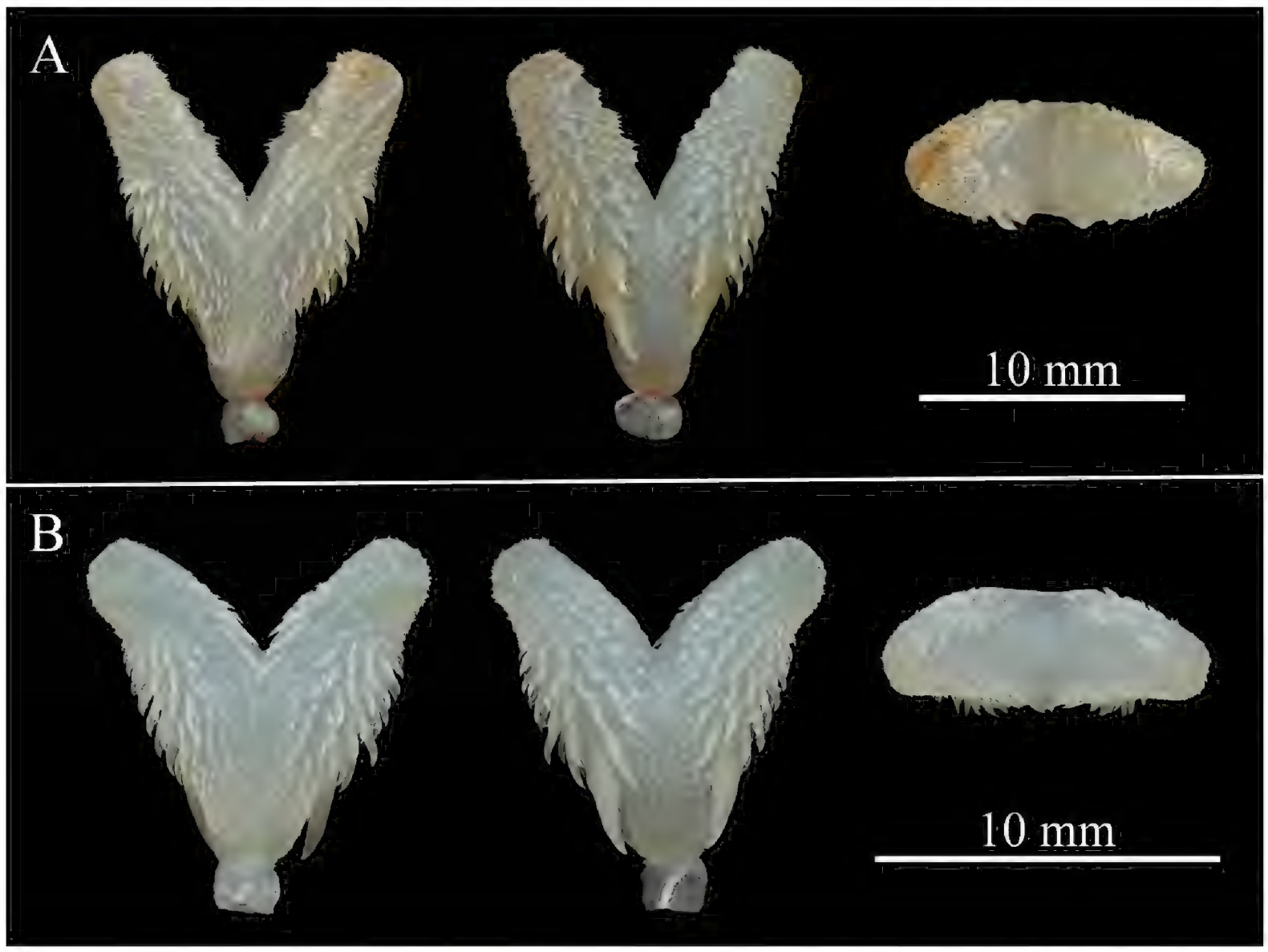

Figure 15. Hemipenis of *Plagiopholis pluvialis* sp. nov. **A**. QHU 2024007, adult male; **B**. QHU 20240006, subadult male. Photos by Yuhao Xu. Scale bars: 10 mm.

Figure 16. Dorsal (left), lateral (middle), and ventral (right) head comparisons between *Plagiopholis styani*, *Plagiopholis acuta* sp. nov., and *Plagiopholis pluvialis* sp. nov. **A**. *Plagiopholis styani*: **A1**. ZJFRR 2022001, subadult male, from Lin'an District, Zhejiang Province; **A2**. ZJFRR 2024001, adult female, from Anji County, Zhejiang Province; **B**. *Plagiopholis acuta* sp. nov.: **B1**. QHU 2024009, adult male, from Xinshao County, Hunan Province; **B2**. QHU 2024010, adult female, from Xinshao County, Hunan Province; **C**. *Plagiopholis pluvialis* sp. nov.: **C1**. QHU 2024007, adult male, from Mt. Qingcheng, Sichuan Province; **C2**. QHU 2024006, subadult male, from Wenchuan County, Sichuan Province. Photos by Yuhao Xu. Scale bars are not shown.

by the Luoxiao, Xuefeng, and Nanling mountains (Zhao et al. 2020), with the Zi and Yuan rivers marking potential geographic boundaries. The newly described *P. pluvialis* sp. nov. occurs along the western and southeastern margins of the Sichuan Basin, including Bijie in Guizhou and the Fanjingshan area in the Wuling Mountains, with no observed overlap in distribution between the species. These may be geographically isolated by either the Yuan or Zi River in central Hunan. This discovery presents new challenges for conservation. Due to their secretive behavior and preference for humid habitats, *Plagiopholis* species are rarely encountered in the wild. In particular, *P. styani* has been documented only a few times over the past two decades. This rarity likely explains why the hidden diversity within this group remained unrecognized for so long. We therefore recommend comprehensive field studies to investigate its distribution, population dynamics, reproductive biology, ecology, and habitat use. Such efforts will be essential for clarifying its conservation status and informing future protection strategies.

Table 6. Main morphological characteristics of *Plagiopholis pluvialis* sp. nov. obtained from the specimens examined in this study, Stejneger (1925), and Zhao et al. (1998). TH: truncus of the hemipenis.

Voucher Number	CIB 119370 holotype	CIB 10176 paratype	CIB 10177 paratype	CIB 10180 paratype	CIB 10181 paratype	CIB 10184 paratype	CIB 10186 paratype
Source	this study	this study	this study	this study	this study	this study	this study
Location	Mt. Emei, Sichuan	Mt. Emei, Sichuan	Mt. Emei, Sichuan	Mt. Emei, Sichuan	Mt. Emei, Sichuan	Mt. Emei, Sichuan	Mt. Emei, Sichuan
Sex	♂	♂	♂	♂	♂	♂	♂
SVL	282	273	306	284	248	248	274
TAL	40	53	50	51	45	53	49
TL	322	326	356	335	292	301	323
TAL/TL	0.12	0.16	0.14	0.15	0.15	0.18	0.15
TAL/SVL	0.14	0.20	0.16	0.18	0.18	0.21	0.18
HL	11.46	12.12	13.81	13.58	11.74	11.97	12.08
HW	7.62	7.60	7.59	8.44	7.25	8.12	7.67
HW/HL	0.66	0.63	0.55	0.62	0.62	0.68	0.63
ED	2.26	3.88	4.37	4.08	3.91	3.98	4.21
MT	/	/	/	/	/	/	/
PRO	1/1	1/1	1/1	1/1	1/1	1/1	1/1
PO	2/2	2/2	2/2	2/2	2/2	2/2	2/2
Lor	0	0	0	0	0	0	0
SL	6/6	6/6	6/6	6/6	6/6	6/6	6/6
IL	6/6	6/6	6/6	6/6	6/6	6/6	6/6
TEMP	2+2/2+2	2+2/2+2	2+2/2+2	2+2/2+2	2+2/2+2	2+2/2+2	2+2/2+2
DSR	15-15-15	15-15-15	15-15-15	15-15-15	15-15-15	15-15-15	15-15-15
VEN	108	109	105	108	110	102	108
SC	27	30	26	28	28	29	27
CP	entire	entire	entire	entire	entire	entire	entire
NB	inverted "V" shaped	inverted "V" shaped	inverted "V" shaped	inverted "V" shaped	inverted "V" shaped	inverted "V" shaped	inverted "V" shaped
TH	/	/	/	/	/	/	/

Voucher Number	CIB 10188 paratype	CIB 10189 paratype	CIB 10192 paratype	CIB 10193 paratype	CIB XMG2023001 paratype	CIB CB25DY01 paratype	QHU 2024006 paratype
Source	this study	this study	this study	this study	this study	this study	this study
Location	Hongya, Sichuan	Mt. Emei, Sichuan	Mt. Emei, Sichuan	Mt. Emei, Sichuan	Chengdu, Sichuan	Mt. Xiling, Sichuan	Mt. Qingcheng, Sichuan
Sex	♂	♂	♂	♂	♂	♂	♂
SVL	261	288	316	286	/	275	272
TAL	46	46	59	51	51	49	49
TL	307	334	375	337	/	324	321
TAL/TL	0.15	0.14	0.16	0.15	/	0.15	0.15
TAL/SVL	0.18	0.16	0.19	0.18	/	0.18	0.18
HL	12.74	13.41	13.79	12.33	/	/	13.13
HW	7.43	7.22	8.88	7.27	/	/	7.81
HW/HL	0.58	0.54	0.64	0.59	/	/	0.59
ED	4.43	/	4.65	3.93	/	/	2.51
MT	/	/	/	/	/	/	18/18
PRO	1/1	1/1	1/1	1/1	1/1	1/1	1/1
PO	2/2	2/2	2/2	2/2	2/2	2/2	2/2
Lor	0	0	0	0	0	0	0
SL	6/6	6/6	6/6	6/6	/	6/6	6/6
IL	6/6	6/6	6/6	6/6	/	6/6	6/6
TEMP	2+2/2+2	2+2/2+2	2+2/2+2	2+2/2+2	/	/	2+2/2+2
DSR	15-15-15	15-15-15	15-15-15	15-15-15	15-15-15	15-15-15	15-15-15
VEN	108	107	108	110	114	106	110
SC	26	26	29	29	27	26	31
CP	entire	entire	entire	entire	entire	entire	entire
NB	inverted "V" shaped	inverted "V" shaped	inverted "V" shaped	inverted "V" shaped	inverted "V" shaped	inverted "V" shaped	inverted "V" shaped
TH	/	/	/	/	/	/	spinulate throughout

Voucher Number	QHU 2024007 paratype	USNM 64427 /	USNM 65456 /	USNM 65506 /	CIB 10178 paratype	CIB 10179 paratype	CIB 10182 paratype
Source	this study	Stejneger (1925)	Stejneger (1925)	Stejneger (1925)	this study	this study	this study
Location	Wenchuan, Sichuan	Mt. Emei, Sichuan	Mt. Emei, Sichuan	Mt. Emei, Sichuan	Mt. Emei, Sichuan	Mt. Emei, Sichuan	Mt. Emei, Sichuan
Sex	♂	♂	♂	♂	♀	♀	♀
SVL	243	/	/	/	283	308	314
TAL	41	/	/	/	34	47	39
TL	284	/	/	/	318	355	353
TAL/TL	0.14	/	/	/	0.11	0.13	0.11
TAL/SVL	0.17	/	/	/	0.12	0.15	0.13
HL	12.45	/	/	/	13.09	12.55	12.41
HW	7.8	/	/	/	7.69	9.10	7.72
HW/HL	0.63	/	/	/	0.59	0.73	0.62
ED	2.33	/	/	/	4.36	4.26	4.43
MT	18/18	/	/	/	/	/	/
PRO	1/1	1/1	1/1	1/1	1/1	1/1	1/1
PO	2/2	2/2	2/2	2/2	2/2	2/2	2/2

Voucher Number	QHU 2024007 paratype	USNM 64427 /	USNM 65456 /	USNM 65506 /	CIB 10178 paratype	CIB 10179 paratype	CIB 10182 paratype
Lor	0	1/1	0	1/1	0	0	0
SL	6/6	6/6	6/6	6/6	6/6	6/6	6/6
IL	6/6	6/6	6/6	6/6	6/6	6/6	6/6
TEMP	2+2/2+2	2+2/2+2	2+2/2+2	2+2/2+2	2+2/2+2	2+2/2+2	2+2/2+1
DSR	15-15-15	15-15-15	15-15-15	15-15-15	15-15-15	15-15-15	15-15-15
VEN	109	109	110	110	116	116	122
SC	30	30	29	30	21	25	25
CP	entire	entire	entire	entire	entire	entire	entire
NB	inverted "V" shaped	/	/	/	inverted "V" shaped	inverted "V" shaped	inverted "V" shaped
TH	spinulate throughout	/	/	/	/	/	/
Voucher Number	**CIB 10185 paratype**	**CIB 10187 paratype**	**CIB 10191 paratype**	**FMAEM paratype**	**SYS r002035 paratype**	**CIB 562295 /**	**CIB 562300 /**
Source	this study	this study	this study	this study	this study	Zhao et al. (1998)	Zhao et al. (1998)
Location	Mt. Emei, Sichuan	Mt. Emei, Sichuan	Mt. Emei, Sichuan	Mt. Emei, Sichuan	Bijie, Guizhou	Mt. Emei, Sichuan	Mt. Emei, Sichuan
Sex	♀	♀	♀	♀	♀	♀	♀
SVL	283	300	285	297	275	311	267
TAL	39	46	35	40	40	43	40
TL	322	346	320	336	315	354	307
TAL/TL	0.12	0.13	0.11	0.12	0.13	/	/
TAL/SVL	0.14	0.15	0.12	0.13	0.15	/	/
HL	12.61	14.15	11.88	13.14	12.48	/	/
HW	7.51	8.20	6.32	8.35	7.24	/	/
HW/HL	0.60	0.58	0.53	0.64	0.58	/	/
ED	4.11	4.49	4.09	/	/	/	/
MT	/	/	/	/	/	/	/
PRO	1/1	1/1	1/1	1/1	1/1	1/1	1/1
PO	2/2	2/2	2/2	2/2	2/2	2/2	2/2
Lor	0	0	0	0	0	1/0	0
SL	6/6	6/6	6/6	6/6	6/6	/	/
IL	6/6	6/6	6/6	6/6	6/6	/	/
TEMP	2+2/2+2	2+2/2+2	2+2/2+2	2+2/2+2	2+2/2+2	/	2+2/2+2
DSR	15-15-15	15-15-15	15-15-15	15-15-15	15-15-15	15-15-15	15-15-15
VEN	122	115	119	115	119	119	118
SC	23	22	22	22	26	24	25
CP	entire	entire	entire	entire	entire	entire	entire
NB	inverted "V" shaped	inverted "V" shaped	inverted "V" shaped	inverted "V" shaped	inverted "V" shaped	/	/
TH	/	/	/	/	/	/	/
Voucher Number	**USNM64429 /**	**USNM64430 /**	**USNM65502 /**	**USNM65505 /**	**USNM66534 /**	**CIB 10183 paratype**	**CIB CB2024EMS001 paratype**
Source	Stejneger (1925)	Stejneger (1925)	Stejneger (1925)	Stejneger (1925)	Stejneger (1925)	this study	this study
Location	Mt. Emei, Sichuan	Mt. Emei, Sichuan	Mt. Emei, Sichuan	Mt. Emei, Sichuan	Mt. Emei, Sichuan	Hongya, Sichuan	Mt. Emei, Sichuan
Sex	♀	♀	♀	♀	♀	J	J
SVL	/	/	/	/	/	/	101
TAL	/	/	/	/	/	/	16
TL	/	/	/	/	/	/	117
TAL/TL	/	/	/	/	/	/	0.14
TAL/SVL	/	/	/	/	/	/	0.16
HL	/	/	/	/	/	/	8.04
HW	/	/	/	/	/	/	4.96
HW/HL	/	/	/	/	/	/	0.62
ED	/	/	/	/	/	/	/
MT	/	/	/	/	/	/	/
PRO	1/1	1/1	1/1	1/1	1/1	1/1	1/1
PO	2/2	2/2	2/2	2/2	2/2	2/2	2/2
Lor	0	0	0	1	0	0	0
SL	6/6	6/6	6/6	6/6	6/6	6/6	6/6
IL	6/6	6/6	6/6	6/6	6/6	6/6	6/6
TEMP	2+2/2+2	2+2/2+2	2+2/2+2	2+2/2+2	2+2/2+2	2+2/2+2	2+2/2+2
DSR	15-15-15	15-15-15	15-15-15	15-15-15	15-15-15	15-15-15	15-15-15
VEN	114	116	118	117	117	/	113
SC	18	22	22	16	26	/	27
CP	entire	entire	entire	entire	entire	entire	entire
NB	/	/	/	/	/	inverted "V" shaped	inverted "V" shaped
TH	/	/	/	/	/	/	/

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